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ABSTRACT

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ECOLOGICAL FACTORS: THEIR INFLUENCE ON LEARNING STYLE AND ELEMENTARY MATHEMATICS ACHIEVEMENT

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Learning styles are defined as "characteristic cognitive, affective and physiological behaviors that serve as relatively stable indicators of how learners perceive, interact with and respond to the learning environment" (Keefe,1979). There is evidence of the existence of individual differences that are distinctive and consistent in the way information is perceived, processed and organized. Some investigators of learning style emphasize one aspect or dimension such as Witkin's (1962) field dependence-independence construct, while others such as Hill (1971) and Dunn and Dunn (1978) include perceptual, affective and physiological as well as cognitive aspects of learning style.

Many learning style theorists consider that one of the factor components of learning style is the person's modality strength or preferred sense modality for acquiring input from the environment. A modality is any of the sensory channels or perceptual systems through which an individual detects and acquires information. The major modalities are visual, auditory and haptic. A person's modality indicates whether the input is more easily perceived, and therefore retained, through the auditory, visual or haptic perceptual system. The visual system includes the ocular mechanism (eyes and muscles for orienting them), while the auditory system includes the ears and the muscles which allow the body to orient them to a source of sound. Usually the term tactile/kinesthetic has been used instead of haptic. However, haptic includes more than touch (tactile) and muscle movement (kinesthetic). It is the sensitivity of the individual to both, the environment and his/her body, with the skin, joints and muscles acting as receptors (J. Gibson, 1966).

There is a lack of agreement among learning style theorists on whether modality preference, which is the individual's personal opinion concerning the perceptual modality through which he/she learns best (Dunn and Dunn, 1978), really measures modality strength. Among those who consider modality preference as an important component of learning style are Hill (1971) and Dunn and Dunn (1978). They take it into account when determining the various factors that make up an individual's learning style. Modality, as well as the other components, is measured by Hill and Dunn and Dunn using self-report instruments which reflect an individual's personal opinion concerning the way he/she learns best. However, Barbe and Swassing (1979) consider that modality strength is determined by the perceptual system through which an individual acquires and retains information most effectively and efficiently as demonstrated by his/her performance on an academically relevant task in each of the three major modalities. There is no empirical evidence to support either side of the argument. Those who say modality strength and modality preference are the same use as evidence the fact that older students and adults are reliable in indicating their own learning style preferences (Copenhaver, 1979;

Domino, 1970; Raines, 1976). Those who disagree explain that the manner in which an individual is most comfortable receiving information is not always consonant with the way in which information is most efficiently received and processed by him/her (Barbe and Swassing, 1979).

Diverse descriptive studies have been done using either the concept of modality preference or modality strength. Findings are contradictory with respect to whether modality is dependent on age, sex or handedness appearing to suggest that modality is innate and independent.

Another component of a person's learning style is Witkin's (1962) cognitive construct of field dependence-independence, that is, whether perception of an item is determined by the surrounding framework. Different versions of the Embedded Figures Test are used to measure field dependence-independence. Field-dependence is the tendency to preserve the holistic nature of an encounter field as demonstrated by the inability to recognize embedded figures while field-independence is the tendency to differentiate the components of an encounter field as demonstrated by the ability to recognize embedded figures (Witkin, 1962). Witkin's theory of cognitive style does not take into account sense modality at all.

It is through the senses that individuals acquire the necessary input for perception. According to J. Gibson (1966), perception is not based solely on having sensations but on detecting information. An individual detects distinctive features and abstracts general properties by selectively attending to certain features while filtering out or disregarding others. The tendency to perceive holistically or analytically affect which features are attended to. The distinctive features and invariants are probably detected more economically and effectively through a particular perceptual system in different individuals. This would seem to indicate that modality and field dependence-independence were two of the basic components of an individual's learning style.

Achievement in elementary school mathematics is the result of a combination of variables. The subject matter itself, the materials and method of instruction, as well as the instructor, contribute. In addition, factors in the individual learner affect his/her achievement. The way mathematics is presently taught in the elementary school has been found to be best suited for field-independent or analytical learners (Speer, 1979; Spitler, 1970). Modality as such has not been explored in relation to elementary mathematics. The use of manipulatives and illustrations has been investigated as parts of a sequence in the development of mathematical ideas but not as means of attending to the diverse modality strengths or preferences exhibited by learners.

Whether ecological factors in the environment, not attributable to socioeconomic level, influence the modality and field dependence-independence tendency of individuals had not been investigated. This researcher wanted to explore the possibility that ecological factors could somehow influence modality and/or field dependence-independence and contribute to mathematics achievement in the elementary school. Ecological characteristics make city areas distinct from one another. Not only is the physical surrounding different in terms of space and its use, the kinds and amounts of sound and visual stimuli present and the types of structures and

traffic patterns, but the interactions that take place in each environment are different. The extent and content of outdoor and indoor activities; the freedom and encouragement to explore the environment and become independent; the variety, quality and challenging nature of planned and unplanned experiences; and the adult or parental involvement in the child's activities are some of the factors that make the ecological environments different.

In Puerto Rico a city includes not only the core, but the surrounding suburbs as well as the rural areas around it. Families of diverse socioeconomic levels make their homes in the city's core as well as in the suburbs or in the country or rural area. Not all affluent families live in the suburbs and not all poor families live in the inner-city. For several years the government built public housing projects, some right in the city's core and others in the suburbs, in order to relocate families who lived in substandard housing. However, during the past decade this was discontinued in favor of giving the families subsidies to pay for homes wherever the family wanted because the housing projects became pockets of a completely different ecological environment from that which surrounded it. As we can see, Puerto Rican cities have four distinct ecological environments: inner-city or urban, suburbs, rural area and public housing projects. The urban environment is adult-oriented with very limited oportunities for outdoor play activities, with much noise, visual stimuli, traffic and crowds, permitting a lot of contact with people and encouraging a type of independence in dealing with the surroundings. Homes are very closed together, streets are narrow, at times sidewalks are non-existent and backyards are tiny if they exist at all. The rural environment permits little contact with people. Houses are far apart or several may be grouped together in one area. Roads are winding and narrow. There is absence of noise and traffic, and although there is plenty of open space, it is not appropriate for child-oriented activites and indoor activities are encouraged. The suburban environment is family-oriented with front and backyards, parks, quiet streets and large sidewalks encouraging recreational activities. There is plenty of contact with selected adults and children are carefully supervised and offered activities that help them to develop socially, physically and intellectually. The public housing environment has low apartment buildings with small open spaces in between that belong to the entire community. It encourages early independence and provides little or no adult supervision. There is plenty of noise and children have a lot of contact with diverse kinds of people. Although there are open spaces between the apartment buildings, children are not encouraged to participate in planned and organized activities like the suburban children.

If ecological group membership were found to contribute to modality, field dependence-independence and/or mathematics achievement, further research could lead to the design of instructional activites that, taking these factors into account, would help all students to achieve to their full potential in mathematics. Following Irving Sigel's (1965) recommendation to make separate analyses for male nd female samples in order to examine the implications of sex differences, their origin as well as their maintenance, sex was taken into consideration in this investigation.

OBJECTIVE

This research was designed to study the interrelationships of modality strength, modality preference, field dependence-independence, sex and ecological environmental group and their contribution to mathematics achievement in the elementary school with the intention of helping to clarify and expand the knowledge available.

DATA SOURCE

Data from four instruments were obtained and analyzed using a combination of descriptive and inferential statistics with alpha set at .05. The instruments were:

1. Learning Style Inventory (Spanish version, Ramirez, 1981)--a self-report inventory that measures modality preference among other factors.
2. Swassing Barbe Modality Index (Swassing & Barbe, 1979)--an instrument that objectively determines modality strength through a match-to-sample task.
3. Children's Group Embedded Figures Test (Lockheed, Harris, Stone & Fitzgerald, 1977)--an instrument that measures competence at overcoming embedded contexts and permits the identification of field-dependent or independent individuals.
4. Mathematics Basic Skills Test (Puerto Rican Department of Education, 1978)--a test that measures mathematics achievement.

The sample used in this study was drawn from children attending fourth grade in the public schools of Caguas, a city in Puerto Rico. Puerto Rican children attend neighborhood schools. Schools were classified according to their location into rural, urban, suburban and public housing neighborhoods based on ecological factors present in their environment. One school was randomly selected from each stratification. Two hundred and fifty-six students from four different ecological environments participated in the study. Due to absences not all participants have results for every instrument.

RESULTS AND DISCUSSION

Modality preference, as measured by the Learning Style Inventory (LSI), and modality strength, as measured with the Swassing Barbe Modality Index (SBMI), are independent of each other (Chi-square= 8.68, df=9). This means that the instruments were measuring different and unrelated constructs. Therefore, each was examined in relation to sex and environmental group. In agreement with previous findings (Barbe and Swassing, 1979; Price, 1980) neither was found to be related to sex.

The hypothesis that modality preference and environment are independent of each other was rejected (Chi-square= 28.11, df= 9, $p<.05$, C= .33). Looking at Table 1, it is observed that 48% of the auditory children live in a rural environment while only 4% live in an urban environment.

Table 1

Percentage of Participants Classified by Modality Preference and Environmental Group (N = 229)

Modality Preference	Environmental Group				
	Rural	Urban	Suburban	Public Housing	Total
Visual	23	21	30	26	(77)
Auditory	48	4	22	26	(27)
Haptic	21	21	38	21	(96)
Mixed	10	48	14	28	(29)

Note. Numbers in parenthesis indicate number of children in modality preference category.

Chi-square = 28.11, df = 9, $p < .05$

Contingency coefficient = .33

The urban environment is characterized by constant bombardment of sound. Does this fact influence urban children to learn at an early age to turn off, to dislike using their auditory system, to think they would do better using another modality to learn? Yet, only 13 out of 54 (24%) rural children prefer the auditory modality. This seems to suggest that rural children who are auditory seem able to accept and express that fact when they are asked about it, while only 1 out of 51 (2%) urban children was able to realize and express that he or she preferred the auditory modality. This could be interpreted to mean that the environment interacts with an individual's modality preference either enhancing or transforming it. A rural environment does not seem to produce auditory learners since only one-fourth of the rural children are auditory. However, it appears to nurture the auditory modality in those that have that tendency since the greatest proportion of auditory learners was found to live in the rural environment. An urban environment, on the other hand, seems to hinder the use of that modality, perhaps forcing individuals to change their preference as a result of exposure to particular experiences.

It is observed that 38% of the haptic children live in the suburbs. A closer look at Table 6, reveals that 36 out of 69 (52%) suburban children expressed a haptic preference. The suburban environment is characterized by lots of open spaces with a large amount of organized and unorganized activities in which children can participate. Front yards, backyards, sidewalks, and parks teem with children involved in all kinds of active play and sports. The rural environment is the only other environment with a lot of open spaces. Yet, hills, backroads, and distance from neighbors do not promote the type of active play that suburban children engage in. Once more, we see that ecological factors seem to be at play, this time encouraging haptic preference in the suburbs.

Out of 29 children who expressed a mixed preference, 14 (48%) live in an urban environment. This could be interpreted as another corroboration of the idea that the environment interacts with an individual's modality preference and transforms it. In order to deal effectively with their environment, these children have had to learn to use all their perceptual systems since their true preference has not been encouraged and nurtured by their experiences. To succeed they have to function using all the modalities or different ones on different occasions.

Modality strength is also related to environment (Chi-square= 17.97, df=9, p< .05) but not as strongly (C= .26). Barbe and Swassing (1979) believe modality strength is shaped by heredity, maturation and environment but give more emphasis to the environment. They see modality strength as changing with exposure to different experiences. A look at Table 2 shows us that 42% of the children classified as auditory with the SBMI live in a rural environment and 33% of those classified as mixed live in an urban environment. These findings provide support to Barbe and Swassing's belief as well as to this researcher's premise that ecological factors contribute to the development of an individual's modality strength.

Table 2

Percentage of Participants Classified by Modality Strength and Environmental Group (N = 256)

Modality Strength	Environmental Group				
	Rural	Urban	Suburban	Public Housing	Total
Visual	18	22	35	25	(109)
Auditory	42	25	15	19	(48)
Haptic	17	30	29	23	(69)
Mixed	30	33	20	17	(30)

Note. Numbers in parenthesis indicate number of children in modality strength category.

Chi-square = 17.97, df = 9, p<.05

Contingency coefficient = .26

Students were classified according to their scores in the Children's Group Embedded Figures Test (CGEFT) into field-dependent (low scores), field-independent (high scores) or undifferentiated. ANOVA revealed that environmental group membership had a significant effect on the CGEFT scores. Table 3 offers the means and standard deviations of the environmental groups.

Table 3

Means and Standard Deviations on CGEFT According to Various Classifications

Classification	n	M	SD
Sex			
Males	120	14.07	6.25
Females	122	12.21	6.57
Environmental Group			
Rural	57	11.18	6.39
Urban	67	12.28	6.38
Suburban	68	15.06	5.78
Public Housing	50	13.86	6.88

Scheffe's (1959) test showed a significant difference between the means of the rural group (11.18) and the suburban group (15.06). The suburban group's variance (5.78) is the smallest which means that the range of scores and therefore, the differences among the suburban children are not as great. This findings could be interpreted to mean that there are ecological factors in the rural environment that seem to promote field-dependence while other ecological factors seem to encourage field-independence in suburban children.

A significant interaction between sex and environmental group was found ($F = 2.865$, $p < .05$). As Figure 1 illustrates, the difference between the sexes is not linear for each environmental group.

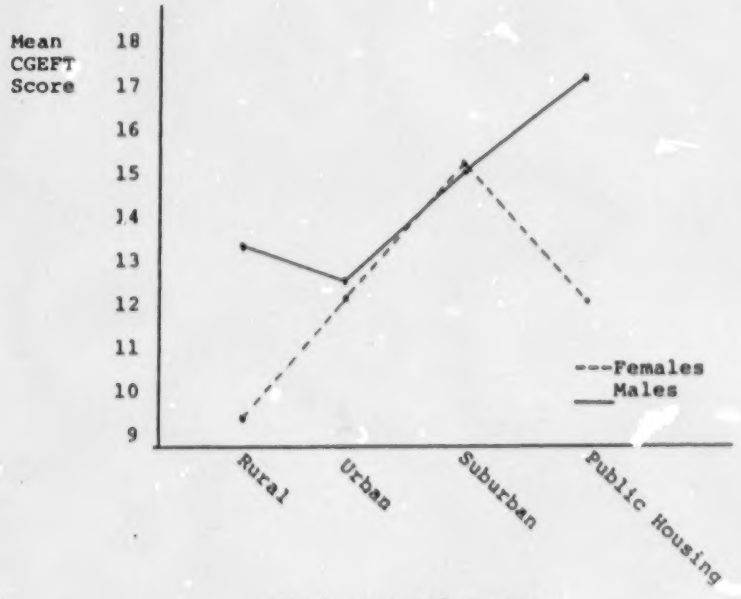

Figure 1: Interaction Effect of Sex and Environmental Group

It is apparent that the difference between males and females is greater in the rural and in the public housing environment. This leads this researcher to wonder if, as Sigel (1965) believes, socialization experiences or other ecological factors are responsible for the differential effect which was observed. Whatever is producing the disparity seems to encourage field-independence in males while at the same time promoting field-dependence in females. Further research needs to be done to determine what these factors are and whether they are the same in the rural and in the public housing environments or whether they are different factors that produce the same results. The urban and suburban environments do not seem to exert the kind of influence which fosters field-dependence in females.

Separate multiple regression analyses were done for males and females with the purpose of determining how much of the variance in CGEFT scores could be attributed to the influence of modality and environmental group membership. The joint contribution of modality

strength and environmental group accounts for 18% ($p < .01$) of the variance for females. Environmental group membership, when entered with modality strength in the regression equation, explains 8% ($p < .01$) of the variance for females. Modality strength's unique contribution was also found to be significant (7%, $p < .05$). Nevertheless, no significant contributions were found for males.

In order to explain in as much depth and detail as possible the phenomenon of interest and due to the exploratory nature of this research, the joint as well as the unique contributuion of each predictor variable to mathematics achievement was analyzed using multiple regression techniques with separate analyses for males and females. Tables 4 and 5 present a summary of results using the full model.

Table 4

Summary of Results of the Multiple Regression Analysis for Females Using the Full Model

Dependent Variable: Mathematics Achievement

Variable	R	R^2	R^2 Change
Field Dependence-Independence (CGEFT)	.57	.33	.33
Environmental Group (G)	.67	.44	.12
Modality Preference (MP)	.69	.48	.03
Modality Strength (MS)	.70	.49	.02

Table 5

Summary of Results of the Multiple Regression Analysis for Males Using the Full Model

Dependent Variable: Mathematics Achievement

Variable	R	R^2	R^2 Change
Field Dependence-Independence (CGEFT)	.36	.13	.13
Environmental Group (G)	.60	.36	.23
Modality Preference (MP)	.60	.36	.00
Modality Strength (MS)	.63	.40	.03

The analyses indicated that a full model including field dependence-independence, ecological group, modality preference and modality strength as predictor variables was statistically significant ($p < .01$) in both cases. The overall effect explains more variance for females (49%) than for males (40%), in either case a substantial amount.

In females, ecological group accounts for 6% of the variance in

mathematic scores if entered by itself in the regression model as can be seen in Table 6.

Table 6

Results of Multiple Regression Analyses Estimating the Unique Contribution of Field Dependence-Independence, Environmental Group, Modality Preference, and Modality Strength to Mathematics Achievement for Females

	Variables			
Models	CGEFT	G	MP	MS
Y = variable alone	33%**	6%	6%	1%
Y = variable + CGEFT	--	12%**	2%	1%
Y = variable + G	33%**	--	7%	3%
Y = variable + CGEFT+G	--	--	3%	2%
Y = CGEFT + G + MP + MS	34%**	14%**	3%	2%

*$p < .05$

**$p < .01$

When all four variables are entered, it explains 14% ($p < .01$) of the mathematics achievement variance for females. Field dependence-independence accounts for 33% ($p < .01$) increasing to 34% ($p < .01$) in the full regression model, explaining the largest proportion of variance. The joint contribution of ecological group and field dependence-independence accounts for 44% of the females' mathematics achievement variance.

In males, ecological group explains 30% ($p < .01$) when entered by itself but when all four variables are entered in the regression equation, its unique contributuion becomes 21% ($p < .01$). Results for males are shown in Table 7.

Table 7

Results of Multiple Regression Analyses Estimating the Unique Contribution of Field Dependence-Independence, Environmental Group, Modality Preference, and Modality Strength to Mathematics Achievement for Males

	Variables			
Models	CGEFT	G	MP	MS
Y = variable alone	13%**	30%**	5%	3%
Y = variable + CGEFT	--	23%**	4%	2%
Y = variable + G	13%**	--	Less than 1%	4%
Y = variable + CGEFT + G	--	--	Less than 1%	3%
Y = CGEFT + G + MP + MS	6%**	21%**	Less than 1%	3%

Field dependence-independence accounts for 13% ($p < .01$) of the mathematics achievement variance when entered by itself but in the full model this contribution is reduced to 6% ($p < .01$). 36% of mathematics achievement variance in males can be attributed to the joint contribution of ecological group and field dependence-independence.

In both males and females, modality strength and modality preference's contributions were not statistically significant.

CONCLUSION

The participants in this investigation lived in the same city and were members of the same cultural group. The stratification was based on ecological characteristics and not on socioeconomic level. Results reavealed that ecological factors in the environment significantly affect an individual's learning style and his/her mathematics achievement. Both, modality strength and modality preference, are related to ecological group membership. Although the relationships are not too strong according to the contingency coefficients, evidence indicates they are strong enough to be of importance. Auditory learners tend to live in the rural environment, mixed in the urban, and haptics in the suburbs. Ecological group membership affects field dependence-independence. Rural children tend to be more field-dependent while suburban children tend to be more field-independent. Significant interactions were found between sex and ecological group. Differences in field dependence-independence attributable to sex are not the same for all ecological groups. In the case of females, field dependence-independence is significantly explained by the joint contribution of modality strength and ecological group membership. A large proportion of mathematics achievement variance can be attributed to the joint contribution of ecological group and field dependence-independence in both males and females. In females, the greatest independent contributor seems to be field dependence-independence, while in males, it is ecological group.

Since previous research had not considered ecological characteristics, the findings of this study open new avenues of exploration in our quest for knowledge on learning style components. Further research must be done to identify the specific ecological factors present in each environment and their interaction with modality and field dependence-independence in males and females. This research has made us aware that children from different ecological environments and of different sex in a particular environment might be perceiving things differently. In order to be able to make instruction more responsive to the needs of students, we must explore further the particular ecological factors that are influencing the children we teach as well as the differential effects these factors have on males and females.

REFERENCES

Barbe,W. & Swassing,R. Teaching through modality strengths: Concepts

and practices. Columbus, Ohio: Zaner-Bloser, Inc., 1979.

Dunn, R. & Dunn, K. Teaching students through their individual learning styles. Virginia: Reston Publishing Co., Inc., 1978.

Copenhaver, R.W. The consistency of student learning styles as students move from English to Mathematics (Doctoral dissertation, Indiana University, 1979).

Domino, G. Interactive effects of achievement orientation and teaching styles on academic achievement. ACT Research Report, 1970, 39, 1-9.

Gibson, J. The senses considered as perceptual systems. Boston: Houghton-Mifflin Co., 1966.

Hill, J. Personalizing educational programs utilizing cognitive style mapping. Michigan: Oakland Community College, 1971.

Keefe, J. Student learning styles: Diagnosing and prescribing programs. Reston, Virginia: NASSP, 1979.

Lockheed, M., Harris, A., Stone, M., & Fitzgerald, M. Children's Group Embedded Figures Test. 1977.

Price, G.E. Research using the Learning Style Inventory. Learning Styles Network Newsletter, 1980, 1 (3), 1-2.

Puerto Rican Department of Education. Prueba de destrezas básicas en matemáticas-3. 1978.

Raines, R.H. A comparative analysis of learning styles and teaching styles of mathematic students and instructors (Doctoral dissertation, Nova University, 1976).

Ramirez, A. Versión en español de inventario de estilos de aprendizaje. 1981.

Scheffe, H. The analysis of variance. New York: John Wiley & Sons, Inc., 1959.

Sigel, I. Rationale for separate analyses of male and female samples on cognitive tasks. The Psychological Record, 1965, 15, 369-376.

Speer, W. "Do you see what I hear?"--A look at individual learning styles. Arithmetic Teacher, 1979, 27, 22-26.

Spitler, G.J. An investigation of various cognitive styles and the implications for mathematics education. (Doctoral dissertation, Wayne State University, 1970). Dissertation Abstracts International, 1971, 32, 3201A. (University Microfilms No. 71-17317).

Swassing & Barbe. Swassing Barbe Modality Index. 1979.

Witkin, H., Dyk, Faterson, Goodenough, & Karp. Psychological differentiation. New York: Wiley, 1962.